HUNTERIAN

ORATION.

1855.

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From the Author

THE

HUNTERIAN ORATION

DELIVERED AT

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BY

JOSEPH HODGSON, F.R.S.,

MEMBER OF THE COUNCIL OF THAT COLLEGE.

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BZP (Hunter)

TO

JOHN SMITH SODEN, Esq.,
LATE SURGEON TO THE UNITED HOSPITAL AT BATH,

THE FOLLOWING PAGES ARE INSCRIBED

IN TESTIMONY OF

THE ESTEEM AND AFFECTION

WITH WHICH HE IS REGARDED BY

THE AUTHOR,

AND AS A MEMORIAL OF

THEIR LONG AND FAITHFUL FRIENDSHIP.

MDCCCLV.

HUNTERIAN ORATION.

This is the thirty-seventh occasion on which the Members of this College have assembled for the purpose of commemorating the birth and doing honour to the merits of John Hunter. I undertake the duty of again bringing this interesting subject before you with extreme diffidence of my own powers to do justice to it, and fully conscious of the importance of the task which devolves upon me. I may, however, with justice hope for some share of your indulgence, when I call to your recollection the deep research, the learning, the talents and the eloquence of my predecessors, who have left, for me, no point in the personal history of John Hunter unrecorded, and scarcely a fact or doctrine in his researches unexplored and unrecited. But, though I do not hesitate to solicit your indulgence to myself, I feel assured that the cultivators of Science will not be wearied by a renewed contemplation of those efforts of this great creative mind by which an insight was obtained into some of the most important mysteries of Nature.

There is no branch of knowledge more interesting than to trace the processes and observe the means by which Man is led to useful discovery, and to track the course which has enabled him to expound the principles which give to his discoveries a place in the Temple of Philosophy. Such contemplations are not merely gratifying as marking the powers of the human intellect in unravelling the intricacies of Nature and supplying knowledge useful to Mankind, but they point out the probable means and encourage hopes of further progress. In tracing the steps by which the mind has collected and combined facts from which it has inferred and arrived at important principles, we pass as it were from the head-springs of observation into the broad streams of consistent knowledge. If we look into the history of many of the most important discoveries in Science, we find that they have been preceded by and often were the result of a rigid investigation of the labours of previous inquirers. It was thus that Newton, and Harvey, and Davy, and Watt, of whose steps in their respective researches we possess authentic records, were led to those great discoveries which have encircled their names with imperishable renown.

Perhaps amongst my present audience there may be some individual who may ask,—What were the great merits of John Hunter? what were the results of his labours which justify you in regarding him as a creative genius and placing him in the rank of a great benefactor to Mankind? by what means did he explain and unravel any of Nature's operations, and to what extent did he enlarge the boundaries and increase the resources of that Science which has for its object the alleviation and cure of Disease?

To this inquirer I would reply, that we regard John Hunter as the Founder of Scientific Physiology, and that his genius and his labours first gave to Pathology and Surgery the characters of rational science and a place in true Philosophy. The great and exalted merit of John Hunter, although the term discovery cannot be applied to it, for it may be traced to the time of Aristotle, was the recognition of one peculiar principle or power pervading all organized existences, causing their formation, nutrition, perpetuation, and varied functions, and giving to them properties, superadded to, but differing from those possessed by all other forms of matter. The great end and object of his researches was to ascertain the workings of this mighty power, and from the facts and phænomena which he observed to deduce the principles or laws which regulate its operations. To this end he endeavoured to survey the vast machinery through which it acts, to observe the varied functions which it causes this machinery to execute, to mark the perturbations which it exhibits, and to deduce from these the principles of true Pathology. From a reference to the operations of this great power he inferred the existence of a principle connecting together the phænomena of organized nature, and he showed that, by a knowledge of the operations of this principle, the infinite varieties of results existing in the Animal and Vegetable kingdoms and distinguishing them from the other divisions of the Creation, are to be explained. It is considered, and justly considered, to be the grand triumph and noblest boast of Man's reason, to have pointed out a power which pervades all Nature, to have expounded the operations of that power, to have noted the laws which it obeys, and to have calculated the effects which it produces, so as to lay open to our admiring perceptions even the mechanism of the Heavens. To the great inventive mind of Newton, who first laid the foundation of the grand discovery of Gravitation, who pursued it to its sublime results and showed to his successors the true methods of its investigation, the first place amongst those who have exalted Man's estate by adding to his intellectual glory is universally and justly accorded. The discoveries of Volta, of Davy, of Oerstedt, and of Dalton, have made known to us powers and developed principles which effect and regulate the combinations of inorganic matter; these discoveries justly place them also amongst the immortal interpreters of Nature's mysteries. And shall we not accord homage to him who, in like manner ascending from the observation of particular facts to general laws, pointed out more strongly than any previous inquirer had done, the ruling power of organization, and traced its course and subtile workings in the construction and purposes of Animated Nature? Shall we not regard him as pre-eminent in science, who expounded to us the operations of that principle which is the essence of organization and which binds together this division of the Creation,—who gave us a theory of organic force to which all the diversities of living formations and their functions are referrible, and who taught us to look to the aberrations of this power as the great source of disease, and to its vast influences as the great means of reparation and recovery? Shall we withhold our admiration from those inquiries which show that in a speck of albuminous matter in the chemical constitution of which the art of Man can discover nothing but a combination of the elementary gases of our atmosphere, there may exist a principle or power, which, when roused to activity by external agencies, becomes the architect of its own habitation and builds up all the marvellous structures which constitute it a plant or an animal?—which converts, by its own peculiar chemistry, "by man's weak art inimitable," the materials with which it is in contact into an infinite variety of exquisite formations—bone, muscle, brain, hair, feathers, leaves, flowers, fruits—giving to each plant or animal powers to continue these organizations, to perpetuate its species, and to sustain its peculiarities, until, the principle of life having left it and no longer preserved by this mighty influence from the ordinary affinities of matter, these beautiful organizations are resolved into their elements? Shall we not acknowledge our gratitude to him who taught us to look beyond the relations of inert matter and to seek in the workings of the vital principle for the causes of disease and the processes of reparation, and thus, by a true course of philosophical investigation, to arrive at rational treatment?

Such were the researches, such were the great objects of his labours whose memory we meet to honour; and to my inquirer I would reply, that, in the history of philosophical discoveries, in vain do we look for loftier conceptions, more certain deductions, or more useful results than those which engaged the deep contemplations and laborious investigations of John Hunter.

But Hunter did not endeavour to explain the nature of this Vital Force. He was content with tracing the phænomena of formation, growth, motion, sensation and volition in the varied machinery in which they exist in organized bodies, and with showing that these phænomena are effected by the agency of one peculiar power. The intimate nature of that power by which such machinery is brought into existence, sustained, and enabled to execute its multifarious offices, he justly regarded as a mystery impenetrable by our thoughts. "Life," he observed, "is a property we do not understand: we only see the necessary steps leading to it*." Such inquiries do, indeed, even yet seem to be reserved as labours for the future, and it may be doubted if Philosophy is ever destined to carry into that loftier scene the facts which she is now laboriously accumulating. Science has pointed out analogies between the nervous power and certain propertics of unorganized bodies, but the chasm which exists between these properties on the one side, and the phænomena exhibited by the nervous power on the other, is too wide to admit of our connecting them, except perhaps as remote analogies. All speculations respecting the intimate nature of the nervous force, though many of them have proceeded from the greatest philosophers who have ever lived, prove only that hitherto the endeavour to comprehend its nature is vain and fruitless. Many anatomical truths have been discovered and some physiological facts have been observed, but no principle by which the nature of this power can be explained. All the trains of research to which this inquiry has been subjected have begun in exact examinations of organization and function and have ended in conjecture and hypothesis. As it has been eloquently observed by a learned author, "the stream of knowledge in all such cases is clear and lively at its outset; but instead of reaching the great ocean of the general truths of science, it is gradually spread abroad among sands and deserts till its course can be traced no longer*."

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* Palmer's edition of the Works of Hunter, vol. iii. p. 124.

Although Man has not been able to ascertain the nature of the nervous or vital force, the same difficulties beset the path of the inquirer into the ultimate nature of any of the great agents which regulate the physical condition of the universe. Who, for instance, can explain the constitution or nature of gravitation or attraction, of light, heat, electricity or magnetism; or who can expound their ultimate connexions with the material existences which are essential to their agency? By each of these expressions we represent an assemblage of ascertained facts, but not the nature of the power by which they are produced and associated. Thus we know the phænomena of gravitation and the laws which they observe, but nothing of the nature of gravity. So also by the term vital or nervous power we represent a peculiar influence or force which produces and regulates the phænomena which characterize animated bodies, but we know nothing of the essential or intimate nature of this power itself.

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* Whewell, History of the Inductive Sciences, vol. iii. p. 431.

There are few problems in physiology which have excited more interest, but about which less is known, than those which relate to the conversion of the materials of alimentation—of the dead matter which is received into the body for the purposes of its nutrition—into the living organizations which constitute its peculiarities. Is this matter, by chemical or vital agencies, resolved into its original or elementary constituents, which are recombined and converted by vital forces into products which bear little or no resemblance, apparent or chemical, to the original materials from which they were elaborated? Or, is Nutrition merely the deposit, in apposite positions, of materials already prepared, as it were, for their destined offices? Science has not yet solved this problem; perhaps both conditions may exist. Nature, in her œconomy, may appropriate materials suitable for its offices without this process of resolution and recombination, but there can be no doubt that in the matchless laboratories of organized bodies the vital force effects decompositions and recombinations which no other power or principle with which Man is acquainted can accomplish. In vain has Man in his laboratories essayed to produce any of the solid or fluid formations which are developed by the operations of the vital organism; he can indeed decompose and resolve them into a few of the elementary constituents of inert matter, but their reconstitution he cannot effect, and can only explain by a reference to the great principle of life. Again, in what stage of assimilation or appropriation to its destined office does the nutriment acquire the principle of life, so as to give to it characters and properties which it did not previously possess in its inert or unvitalized condition, and which appear to be essential to its being incorporated with the living organism? Although Science has not yet expounded this problem also, the importance of the inquiry did not escape the deep perceptions of Hunter, who clearly demonstrated one of the most important principles connected with the science of organization, namely, that the vital forces are not restricted to solids, but are also possessed by, or are displayed in, some of the fluids of the animal body. We are indeed more accustomed to connect the idea of life with a solid than with a fluid, but he was convinced that there was no more reason why it should exist in connexion with one of these forms of matter than with the other. That all aliment is reduced, in the first instance, to a condition of fluidity is certain : this is the first of those processes which we term Digestion ; but in which of its subsequent conditions before it is finally appropriated to organic formation the aliment first acquires the properties of life is unknown. Hunter, however, satisfied himself that this property does exist in the constitution of the Blood, as had been anticipated by Harvey. Harvey came to this conclusion from observing that a spot of blood is the primary animate particle in the embryo, that this spot of blood builds up the first rudiments of organization, and hence, that in this spot of blood, the principle of life, the power of organization, must exist*. But Harvey did not further extend his researches on this point. "Hunter, on the contrary," says the most enlightened historian of his discoveries and labours, Professor Owen, "carries a series of calm and philosophical investigations on the vital properties of the blood to an extent which has never been surpassed; he examines it under every condition, both in the vessels and out of the vessels, during circulation and at rest, in health and in disease. He aims to establish the period in its formation at which it manifests the vital properties; and he fully details the changes which it undergoes, and the phænomena which supervene in the rest of the organism when these properties are lost. Lastly, he tells us how the blood, by means of its vital properties, assists in the restoration of parts when injured or diseased†." The blood differs in its appearance when examined by the naked eye, or with the aid of the microscope, from every other fluid with which we are acquainted; chemistry in vain attempts to compound a fluid possessing the same appearances or properties, and is able to detect in it but few elementary components. When in motion, or immediately after its removal from the living body, it spontaneously separates into different parts, each of which is employed in some of the purposes of organization. To what is this state of fluidity owing? Certainly not to mere motion in the course of circulation, for it is impossible by agitation, when removed from the body, to preserve it in its normal condition. Nor is it heat which keeps it in a fluid state, for, when removed from the body though still exposed to the same temperature, it coagulates, and in cold-blooded animals it exists in its unseparated or fluid condition. Does it derive from the nerves which supply the vessels through which it circulates a principle which keeps it in its fluid state, which gives to it the peculiarities of its composition, and fits its component parts for the purposes of organization? Such was the opinion of Hunter, who considered the blood as exhibiting the first indications of the union of the vital power with dead matter, as "the most simple body," he says, "we know of endowed with the principle of life*."

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* De Generat. Animalium, Exercit. 51, 52.

† Palmer's edition of the Works of Hunter. Preface to vol. iv. p. xii.

The observations even of Hunter†, as well as of more recent physiologists, with regard to some of the properties of chyle, the discoveries of modern science in embryology, and the doctrines of cell-formation, may perhaps allow some doubt to be entertained on this point; but there can be no doubt that the peculiarities observable in the blood are owing to the agency of the vital principle, and most probably to its union with that power. All the observations, experiments and reasoning which have been adduced by Hunter and his successors sanction this conclusion.

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* Palmer's edition of the Works of Hunter, vol. iii. p. 104.

† Ibid. vol. iii. pp. 67, 117.

The doctrine of the vitality of the blood appears to have been a subject of great interest to Hunter, and so desirous was he to establish his convictions with regard to it by mature investigations that he had not published them at the time of his death. Had he left us no other memorial, his posthumous Treatise on the Blood, although in some parts his views are obscured by peculiar expressions with which he endeavoured to represent them, would have been a lasting proof of the depth of his perceptions and the accuracy of his inductions.

That vexed question, the source and cause of Animal Heat, which has occupied so much of the attention both of physiologists and chemists, was deeply investigated by Hunter, whose observations and experiments on this subject show

how diligently he accumulated facts, how cautiously he reasoned upon them, and how slow he was in referring to any, however favoured principle, results which had not been fully elucidated. He examined various conditions, both of animals and vegetables, in which heat is produced, and the powers which living bodies possess of regulating their temperature, and of resisting the influence both of heat and cold; he endeavoured to determine the degree to which the production of heat is connected with various functions of the animal organism, and the influence which it has upon the evolution and healthy maintenance of organization. But he did not regard it as dependent upon the nervous system; he says, "it is most probable that it arises from some other principle; a principle so connected with life that it can and does act independently of circulation, sensation, and volition, and is that power which preserves and regulates the internal machine*." It was reserved, however, for Sir Benjamin Brodie to prove that when the brain ceases to exercise its functions, although circulation and respiration may be continued, the animal loses the power of generating heat, and hence to show that the production of animal heat is dependent upon, and modified by, the nervous influence*. The fact probably is, that the evolution of animal heat is the result of the union of the elementary particles or constituents of matter in the various functions of organization and secretion; that it is a chemical result attendant upon such combinations, and arising from the same causes which produce its evolution in the union of various forms of inert matter unconnected with organization or the vital principle, and which the chemist can produce in his laboratory. But the sources of these chemical combinations in the living body are to be found only in the influence of the vital forces, which must therefore be regarded as the primary cause of the production of heat in organized bodies. Thus the two series of observations, that of Hunter and that of Sir Benjamin Brodie, may be reconciled and combined in the formation of one hypothesis as to the production of animal heat, namely, that the generation of heat is the consequence of the chemical combinations of the elementary particles of matter in the processes of organization and secretion, but that the efficient agent of these combinations is the nervous or vital power itself.

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* Experiments and Observations on Animals with respect to the power of producing Heat. Phil. Trans. vol. lxv.

So likewise with regard to Secretion, the formation of those products which are the result of new combinations of the elementary constituents of the body is a chemical action, but the agent which causes these extraordinary and peculiar unions is the vital or nervous force. The natural operations of this force effect those inimitable combinations which characterize each particular kind of secretion in health; but when suitable materials for the elimination of the natural product are not supplied, or when the operations of the nervous force are disturbed, either by direct interference with the organization which is essential to its existence or by commotions or irregularities in its production, the secretions become vitiated and disease is the consequence. The latter kind of interference with the healthy procedure of secretion, daily observation affords us abundant opportunities of witnessing in the effects of mental emotions and the influences of disorder in other organs. But the most striking illustration of the fact that interference with nervous organization produces derangement of the functions of secretion, is perhaps afforded by the remarkable experiments of M. Bernard of Paris, which show that under the influence of such interference a chemical action may take place capable of generating a substance which, previous to his inquiries, had been known only as the product of the vital chemistry of plants or of disease in the human being. This physiologist found that when a certain part of the brain is wounded, however slightly, as by the insertion of a fine needle into it, the formation of sugar in the secretion of the kidneys takes place, none of the other great animal functions being disturbed. The formation of sugar in this secretion continues as long as the irritation of this particular spot in the brain remains, but, when this has ceased, it disappears*. This fact shows that a slight injury to a particular portion of the nervous apparatus is capable of affecting, in a remarkable manner, a peculiar secretion; it teaches us also, if any addition to the facts which we previously possessed is necessary, to search in very remote organs for the causes of many of those morbid results which have perplexed pathological inquirers.

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* Physiological Researches, collected and republished from the Philosophical Transactions of 1811 and 1812.

I shall trouble you with only one more illustration of the sagacity with which Hunter applied his physiological views with regard to the vital principle to the elucidation of remarkable facts connected with organization. How does it happen that particular structures are preserved from the irritating or even chemical influence of those materials of which they are the compounders or recipients, and which, if brought into contact with neighbouring structures, produce in them the most exciting and destructive effects? The intestinal canal, the gall-bladder, and analogous receptacles, may probably be preserved from those baneful effects which ensue when the materials of which they are the natural recipients are effused amongst neighbouring tissues, by the coating of mucus which is smeared upon their internal surfaces,—such at least is the explanation generally entertained of this fact; but what preserves the Stomach, which can digest almost everything else, from being digested, during life, by its own secretions? Surely this cannot be the mucus with which its internal surface is also smeared, for mucus is found to be digestible. Hunter perceived that, under certain circumstances of death, this did actually happen. He found the stomach itself digested in men who had each died by a violent death; both had been previously in sufficient health to eat a hearty meal. Subsequent observations and experiments upon animals have generally shown that when the stomach is digested after death, these have been antecedent conditions—a full meal and sudden death. Now Hunter, in his very ingenious disquisition relating to the recovery of persons apparently drowned, draws a distinction between what he calls absolute universal death and such a cessation of all the actions by which life is supported as can never be recovered from. The latter state is generally attended with stiffening of the body, arising from contraction or rigidity of the muscles and coagulation of the blood, both of which conditions are believed to be the results of vital actions—the last operations of the vital power. But in the other, the violent form of death, as when produced by lightning or the division of the upper part of the spinal marrow, the absolute universal death referred to by Hunter, the body does not stiffen, nor does the blood coagulate; the vital principle seems to be suddenly and altogether abstracted, and, under such circumstances, the stomach, being suddenly deprived of that preservative influence which it had previously received from the vital forces, becomes amenable to the chemical action of its own secretions which had been excited by the stimulus of the previous meal. The power, therefore, which preserves the living stomach from being digested by its own secretions, Hunter referred to the vital influence. Perhaps I may be permitted to observe, that, having some years ago repeated the experiments upon animals by which this conclusion was supported, and having had some opportunities of finding the stomach digested after death in the human body, this occurrence, as far as my observations extend, has always been attended with the conditions and circumstances which I have now endeavoured to describe.

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* Leçons de Physiologie expérimentale, par M. C. Bernard. Quinzième Leçon. See also Todd, On the Resources of King's College, London, for Medical Education. 1852, p. 38.

I have thus attempted to bring before you some of the most important subjects in Physiology which were investigated by Hunter; these constitute, however, only a portion of those mental labours which entitle him to the highest scientific fame, although they may be regarded, perhaps, as embracing the most abstruse and elevated considerations arising from those researches which he pursued with undeviating constancy throughout his life. Some idea of the amount of his intellectual exertions may be formed from a mere enumeration of his Works. From the year 1760 to 1792 he contributed valuable papers to the Royal Society on the anatomy of rare animals; on many subjects in physiology and pathology; on suspended animation; on animal heat and on digestion; and he also delivered to that Society the Croonian Lectures on Muscular Motion. He published large volumes on the teeth, on various diseases, and on several subjects connected with the animal œconomy;

and finally he had compiled, though it was not published at the time of his death, his great work on the Blood, Inflammation, and Gunshot Wounds. He likewise left ten folio volumes of manuscripts, nine being on Animal and one on Vegetable Anatomy, and several volumes and other records of cases and dissections. He continued throughout nearly thirty years to diffuse the results of his investigations and to impart the spirit of his inquiring energies to students by lecturing on Anatomy and Surgery. When to these exertions we add, that during a large portion of the time which they occupied he was also engaged in the laborious avocations of extensive practice in our profession, and in not less anxious cares connected with his charge of a public hospital, we cannot but admire the untiring zeal and industry which enabled him to accomplish so much in a life which did not extend beyond three score and five years. Of his merits in Philosophy, of his powers to search into nature and to inquire into the causes of effects, his published works will constitute the most enduring monuments. But it is not for these alone that the memory of Hunter claims the grateful homage of this College. That magnificent Museum which constitutes the pride and glory of our institution, which is confided to our care by the bounty of our country, and has recently been enlarged through its liberality, which knows no rival, and which has originated and aided investigations that have vastly extended the boundaries of natural knowledge,—was designed and founded by him, who spared in its formation neither time, nor health, nor wealth.

In one great division of his Museum Hunter had collected illustrations of almost every fact then known relating to organization, or tending to illustrate the views which he entertained as to the operations of the Vital Principle. His chief object in the formation of this division of his Museum seems to have been to display the operations of the Vital Force in the construction of living beings, from the simplest forms of vegetable and animal existence to its most elaborate constructions in Man, to mark the gradations of form which exist in the different genera and species, and to point out those changes in development which give rise to these links in the chain of animated bodies.

Nor were his objects in the construction of his Museum directed exclusively to the illustration of physiological or pathological doctrines. Hunter was convinced that organization constituted the only true basis of a Systematic Classification of the Animal Kingdom. He felt that reference to external configuration, appearance, or habit, could not furnish a natural or scientific ground for such an arrangement; and, believing that unity of design existed throughout this division of the Creation, he sought for some organ or class of organs pervading the different groups of animals, the modifications of which produced or influenced the differences of construction and habits by which each variety is distinguished. Amongst his manuscripts several plans for the systematic arrangement of the Animal Kingdom founded on these principles were preserved, but he did not survive, or was too much engaged by other avocations, to perfect his original and important views on this subject. The illustrious Cuvier, treading in the path in which Hunter had preceded him, adopted organization as the only true basis of a classification of animals, and, from an extensive survey of animated nature and a careful investigation of organization, produced an arrangement of the Animal Kingdom far more perfect and infinitely more scientific than any that had preceded it. Cuvier carried his knowledge of Comparative Anatomy and Zoology into fields of research which enabled him to expound some of the most extraordinary phænomena which are observed in the history of our globe, showing the changes which it has undergone in past ages and the kinds and peculiarities of the living beings by which it was then inhabited. His researches in Comparative Anatomy enabled him to open up new sources of explication to Geology, and not only to reconstruct from the vestiges of extinct creatures the forms which they possessed when alive and to determine their habits and relative position in the great scale of living beings, but also to fix the relative periods at which the principal strata which constitute the crust of the earth were formed. Hunter, aware of the great interest which belonged to them, had also directed his attention to the remains of extinct animals, and had added to his Museum the largest number of specimens of Fossilized Remains at that time in this country. Hunter placed together for the purposes of comparison the remains of the extinct species and the corresponding parts of some existing animal, thus showing that he had adopted the course employed by Cuvier in fixing the position to which the former belonged in the scale of animal formations; and his observations on fossil bones, published in the Philosophical Transactions *, clearly show that he was fully aware of the importance of these investigations

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* Vol. lxxxiv.

as elucidating the physical history of the earth. I need only refer you to the Museum of this College and to the published works of Professor Owen to prove to what great results the labours of Hunter and Cuvier have led, by exciting the comprehensive and inquiring talents of our enlightened Hunterian Professor to follow the footsteps of these his great predecessors in Philosophic Zoology, and to show the vast success with which he has employed the principles of Analogy or Resemblance, and Homology or Identity, in extending our knowledge of animal structures and functions, in fixing their true place in the system of animal organization of an infinite number of extinct and living creatures, and in elucidating the physical history and past changes of our earth.

Hunter first elucidated the circumstances which are observed in the formation of some kinds of Animal Monstrosities, and this he did by reference to a great principle which he found to pervade the entire range of the animal creation. He traced the course of animal formation from its most simple to its most complicated condition, and he found that the most complicated commences in its first or embryonic state in a mere cell or bag, such as in the lowest scale of the animal creation constitutes the entire animal throughout its existence. To this other parts or organs are added as the scale advances, each addition adapting the creature to a difference of functions and habits, until, by the superaddition of fresh organs, the most perfect form of development is effected. Each accession of parts or organs, marked by a corresponding addition of functions and habits, indicates the steps or changes which constitute the varieties, species, orders, and genera which the naturalist recognizes in his arrangements of the Animal Kingdom. Now if from any cause the full course of development is interfered with, a stoppage or arrest in the construction takes place, and the formation of the entire creature or organ (for the principle applies to the development of organs as well as to that of the entire being) stops at that stage which is the type of some inferior production in the scale of organized existence, and represents some other formation. Hunter observed that such was the condition of many of the most interesting examples of monstrosities, or arrests of development, as they are now more correctly termed, which formed a part of his Museum, and these he studied with curious interest for the purpose of ascertaining the laws which regulate their production. This doctrine has been employed as the basis of explanation and arrangement of this subject by some continental writers, espceially in France, and is not the only instance in which the results of Hunter's labours have been rediscovered in that country. The direful wars which, soon after the death of Hunter, separated this country and France, impeded the interchange of scientific knowledge, and until more recently the merits of Hunter were scarcely known or recognized by the physiologists of that or the other countries of Continental Europe. The principles, however, which he developed relating to the science of life, are now acquiring their just place and estimation amongst the ascertained facts of science, and will soon arrive at that position which converts the great discoveries of one age into the common elements of knowledge in the next.

Our time will not allow me to bring before you the great results which Hunter obtained from the application of his philosophic views of life and organization to the elucidation of disease and the improvement of its treatment. He may be regarded as the first who applied the great truths of Anatomical and Physiological Science to these most important subjects by tracing the processes which Nature employs in the construction of organic changes, in building up new formations, and in repairing the effects of injury or disease.

But it was not by his scientific labours alone that Hunter conferred immense benefits upon the human race. The success which attended his modes of research, his untiring industry, the contemplative habits of his mind, and his unbounded zeal, pointed out the means and inspired his disciples and successors with an ardour in similar pursuits, by which the boundaries of those sciences have been vastly extended which have for their object the amelioration of the condition and the relief of the sufferings of our fellow-creatures. If Bacon in his day was correct in his remark, "Medicina igitur (uti perspeximus) adhuc ita taliter comparata est, ut fuerit magis ostentata quam elaborata, etiam magis elaborata quam amplificata*," surely the same observation cannot be applied to the state of Medicine at the present time, which may be justly said to have made at least equal progress with any other division of human knowledge, and to have advanced more during the present half-century than in the 1800 years which preceded it. Amongst the disciples of Hunter who have contributed to these great ends, and whose memory we cherish as bright ornaments of our College, are the illustrious names of Abernethy and Sir Astley Cooper. And here I cannot mention the name of the latter without expressing the sincere regret with which we all regard the removal from amongst us of his distinguished nephew, who on the last occasion for which we are now assembled held the position the duties of which I have so inadequately performed. His manly uprightness, his open benevolent disposition, his zeal and industry in the pursuit of professional knowledge, evinced not only in his published works but in the discharge of his duties as a teacher and in connexion with one of our noblest institutions, and the interest which he felt in his office as a member of the Council of this College, justified us in hoping that Bransby Cooper was destined for a long career of prosperity and useful exertion. But it was ordained otherwise; and, having been associated with him in his earliest professional studies, I feel an affectionate interest in offering this tribute to the many excellent qualities both of mind and heart by which I know that my friend was distinguished.

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* De Augmentis Scientiarum, lib. iv. cap. 2.

There is another disciple of Hunter whose memory is justly dear to the whole human race— who was the inmate of his house and imbibed from him those habits of patient inquiry into the properties and workings of apparently even the most insignificant of Nature's productions, which led to the greatest boon by which Providence hath vouchsafed to relieve the personal sufferings of Man. The grand discovery of the immortal Jenner, to whom I allude, may be pointed to as a blessing unequalled by any in its importance and results which medicine or any other science has conferred upon mankind. The value of the discovery of Vaccination can only be estimated by contemplating the effects which it has produced upon the numerical condition of the population. It has been truly observed that "if smallpox were as fatal now, with our population of twenty millions, as it was during the latter period of the last half-century or before vaccination, it would destroy in Great Britain alone 80,000 lives a year, for with a population of eight millions, it then yearly produced a mortality amounting to 30,000 or 40,000 deaths*." Military science boasts of the discovery during the last half-century of innumerable inventions for the destruction of Man and his works—of improved bombs and shells, of rockets and rifles, by which the destruction of thousands of our fellow-creatures can be more easily effected than formerly. But the simple discovery of vaccination has been the means of preserving, during this time, infinitely more lives than all the arts of the soldier have been able to destroy. And are not then medical science and those pursuits by which the sum of human life and human happiness is so much promoted, entitled at least to equal consideration and equal renown with the invention and employment of those horrible contrivances to which I have alluded ?*

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* The Modern Advancement of Practical Medicine and Surgery, by J. Y. Simpson, M.D., p. 15.

But let us look to the future. The time must surely come when the arts of destruction shall bend before the works of peace ; when those pursuits which increase our powers, which avert or relieve our sufferings and which diffuse health and comfort among the people, shall occupy that position and that consideration which reason and right feeling justly accord to them.

And now the time has arrived when I should bring to a conclusion these remarks, which perhaps may have wearied my audience. I cannot, however, do so without asking your indulgence for a few moments to enable me to state one or two reflections to which they justly give rise.

In the first part of this address I endeavoured to show to you by what means and with what success the efforts of a great, original and untiring intellect, such as has rarely been devoted to the investigation of any one branch of science, were

* See Ibid. p. 16.

employed in exploring the phænomena which characterize animated nature, and in endeavouring to ascertain the power, and to determine the laws observed by that power, which constructs the organizations and regulates the functions of living beings. We saw with what minute accuracy and unceasing labour he surveyed the facts connected with life in their infinite varieties, as exhibited both in the animal and vegetable kingdoms,—with what diligence he interrogated Nature by experiment, and how cautiously he conducted his inquiries into the principal processes of the animal œconomy, employing all these means as lights arising from various sources to illuminate the object of his research. And yet, to what did these great efforts of superior intelligence lead—where did his investigations stop—what was the point in them beyond which the observation of Man could not penetrate? He could indeed note the phænomena which occupied his researches, observe the laws which they obey, and refer them to the agency of one great principle. But here he had arrived in his investigations at the limit which is given to the finite capacity of Man, which is permitted, by the Divine power that created and governs the universe, to note the means which are employed and the laws which they observe in effecting His omnipotent designs,

—but not to comprehend their ultimate or essential nature. All reason tells us that the great results evinced in the constitution of the universe, as well as in its moral government, must have a final cause, and bids us to look to the great Author of nature as the source of those means which are the attributes of His greatness and the instruments of His wisdom and goodness. And shall we, convinced by its works of the existence of that Almighty power, but unable to comprehend the ultimate nature of any of its attributes, attempt to define the limits of its agencies? Universal Nature attests that all her laws were originally imposed by a supreme intelligent Cause, and shall we doubt whether He who has imposed these laws has the power to suspend or modify them? These reflections lead us to submit our reason to receive the sacred truths of revelation, and to confide, with fit humility, in the divine dispensations which it imparts.

Such are among the sublime convictions that spring from the contemplation of the phænomena of the material world. "Far is it from vain and idle," saith a reverend author, "to contemplate the beauty of the heavens, the order of the stars, the lustre of light, the vicissitudes of day and night, the monthly course of the moon, the temperature of the seasons, the immense abundance of seeds and animals reproducing species and individuals, each preserving its proper generic nature and condition. For in this contemplation a vain and perishable curiosity is not to be exercised, but an advance is to be made towards objects immortal and perpetually enduring. For it is not the authority of the divine books alone which proclaims a God; but every argument from things surrounding us, and to which we ourselves bear relation, attests it likewise; since universal nature declares itself to have proceeded from a supremely excellent Creator, whose eternity is understood from its perpetuity; His omnipotence from its greatness; His wisdom from its order and disposition; and His goodness from its government*."

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* St. Augustine, de Verâ Religione. See Conybeare on the Application of Classical and Scientific Education to Theology, p. 15.

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